

09706854-110700

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT WE, Makoto Saotome, a citizen of Japan residing at Kawasaki, Japan and Nobuhide Maruo, a citizen of Japan residing at Kawasaki, Japan have invented certain new and useful improvements in

COMMUNICATION DEVICE

of which the following is a specification : -

TITLE OF THE INVENTION

~~COMMUNICATION DEVICE~~

BACKGROUND OF THE INVENTION

5 This application claims the benefit of a Japanese Patent Application No.2000-156441 filed May 26, 2000, in the Japanese Patent Office, the disclosure of which is hereby incorporated by reference.

10 1. Field of the Invention

The present invention generally relates to communication devices, and more particularly to a communication device which has a function of controlling a disconnection of a line which is being used for a communication when an abnormality is detected in a computer equipment which is coupled to the communication device.

2. Description of the Related Art

20 In a communication using a communication device such as a modem which is coupled to or built into a computer equipment, control related to disconnection of a line which is being used for the communication is in most cases carried out based on a signal received from the computer equipment. For this reason, if a failure or the like occurs in the computer equipment and a line disconnection instruction is not correctly issued from the computer equipment, the line remains in a connected state. When the line remains in the connected state, the accounting continues to be made with respect to the use of the line and the connection to a destination. Recently, there are more occasions to make a communication using a combination of the computer equipment, the communication device and a wireless telephone set. Consequently, in addition to the problem of the continued accounting being made when the failure is generated in the computer

09706854-110700

enc A17

equipment, the wear of a battery of the wireless telephone set due to the continued communication is also becoming a problem.

With respect to the above described
5 problems, a first method has been proposed to
disconnect the line by detecting a no-communication
state which is generated when an abnormality is
occurs in the computer equipment. However,
according to this first method, the no-communication
10 state is not necessarily caused by the abnormality
state of the computer equipment, and it is difficult
to accurately detect the abnormal state of the
computer equipment. As a result, there is a high
possibility that an unwanted disconnection of the
15 line will be made.

On the other hand, a second method has
been proposed to transmit an exclusive control code
with respect to the communication device when an
abnormality is generated in the computer equipment.
20 However, according to this second method, it is
necessary to modify the hardware and software of the
computer equipment from the existing hardware and
software in order to generate the exclusive control
code.

As described above, it is conventionally
25 impossible to disconnect the line by accurately
detecting the abnormal state of the computer
equipment using a simple structure or, to disconnect
the line by accurately detecting the abnormal state
30 of the computer equipment without the need to modify
the existing hardware and software of the computer
equipment.

SUMMARY OF THE INVENTION

35 Accordingly, it is a general object of the
present invention to provide a novel and useful
communication device in which the problems described

09706854-11000

above are eliminated.

Another and more specific object of the present invention is to provide a communication device which can disconnect a line by accurately
5 detecting an abnormal state of a computer equipment, without having to modify existing hardware and software of the computer equipment, and by use of a simple structure.

Still another object of the present
10 invention is to provide a communication device characterized by detecting means for detecting a signal peculiar to a universal serial bus (USB) obtained via the USB, and disconnecting means for
15 disconnecting a line which is being used for a communication when the signal peculiar to the USB is not detected by said detecting means within a predetermined time.

The signal peculiar to the USB may be selected from a group of a frame start (SOF) signal,
20 an interrupt transfer request signal, a control transfer signal and a bulk IN transfer request signal.

According to the communication device of the present invention, it is possible to disconnect
25 a line by accurately detecting an abnormal state of a computer equipment, without having to modify existing hardware and software of the computer equipment, and by use of a simple structure.

Other objects and further features of the
30 present invention will be apparent from the following detailed description when read in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

35 FIG. 1 is a system block diagram showing a first embodiment of a communication device according to the present invention;

09706854-110700

FIG. 2 is a flow chart for explaining the operation of the first embodiment;

FIG. 3 is a diagram for explaining the first embodiment; and

5 FIG. 4 is a diagram for explaining a second embodiment of the communication device according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

10 A description will be given of various embodiments of a communication device according to the present invention, by referring to the accompanying drawings.

15 FIG. 1 is a system block diagram showing a first embodiment of the communication device according to the present invention. In this embodiment, the present invention is applied to a case where a host unit communicates via the communication device and a wireless telephone set.

20 As shown in FIG. 1, a communication device 1 connects a host unit 2 and a wireless telephone set 3. The communication device 1 is connected to the host unit 2 via a universal serial bus (USB) 4. In addition, the communication device 1 is connected
25 to the wireless telephone set 3 via a data line 5-1, a command line 5-2 and a control line 5-3. The wireless telephone set 3 is connected to a network 6 via a line, and connects to a remote unit (not shown) via the network 6.

30 The communication device 1 includes a USB interface (USBIF) 11, a data controller 12, an interrupt detector 13, a timer 14 and a line controller 15. The host unit 2 is formed by a computer equipment such as a personal computer which
35 has a known structure including a CPU (not shown). An application software 21 and a driver software 22 are executed by the CPU of the computer equipment

09706854-110700

5 The USB 4 is a standardized serial bus
which connects a personal computer and a peripheral
equipment thereof. By transmitting signals using
the USB 4, it is possible to manufacture the
peripheral equipment at a low cost. Hence, existing
0 personal computers employ the USB 4 as a standard,
as an external bus. This embodiment effectively
utilizes the USB 4.

During a normal operation, the host unit 2 connects via the application software 21 and the driver software 22 to the line, via the communication device 1 and the wireless telephone set 3, to transmit and receive data. The communication device 1 detects a change in the data transmitted from the wireless telephone set 3 and received via the data line 5-1 or, a change in a command received via the command line 5-2, and stores change information related to the detected change in an internal buffer (not shown) of the communication device 1. For example, the internal buffer may be provided within the data controller 12, within the line controller 15 or, within the USBIF 11.

In order to detect a change of state of the communication device 1, the host unit 2 issues an interrupt transfer request with respect to the communication device 1 at predetermined time intervals. The interrupt transfer request is made by transmitting an interrupt transfer request signal to the communication device 1 via the USB 4. This interrupt transfer request signal is peculiar to the USB 4. An interrupt transfer is made when periodically transferring small amounts of data from

the communication device 1 to the host unit 2. For example, the change information stored in the internal buffer is transferred from the communication device 1 to the host unit 2 by the interrupt transfer. Because of the structure of the USB 4, a data transfer cannot be started from the communication device 1 even in the case of the interrupt transfer. The data transfer is started by a polling operation which is carried out by the host unit 2 to determine whether or not data to be transferred to the host unit 2 exists within the communication device 1.

The communication device 1 constantly monitors the existence of the interrupt transfer request made via the USB 4. More particularly, the interrupt detector 13 detects the interrupt transfer request signal which is received via the USBIF 11. When a detected time interval of the interrupt transfer request signal is within a detection time interval which is preset in the timer 14, the interrupt detector 13 judges that the operation of the host unit 2 is normal, and the communication via the line which is connected to the wireless telephone set 3 is continued. In this case, the data received via the USB 4 are transferred to the wireless telephone set 3 via the USBIF 11, the data controller 12 and the data line 5-1. In addition, the command received via the USB 4 is transferred to the wireless telephone set 3 via the USBIF 11, the line controller 15 and the command line 5-2. Furthermore, the control signal received via the USB 4 is transferred to the wireless telephone set 3 via the USBIF 11, the line controller 15 and the control line 5-3.

On the other hand, when the detected time interval of the interrupt transfer request signal is longer than the detection time interval preset in

09706354-110700

FIG. 2 is a flow chart for explaining the operation of this first embodiment. In FIG. 2, a step S1 sets an upper limit value of the timer 14, and sets the line disconnecting method which is to be employed. A step S2 starts a communication via the wireless telephone set 3 based on a communication request signal from the host unit 2, and starts a count of the timer 14. A step S3

00706854-110700

decides whether or not a counted value of the timer 14 exceeds the set upper limit value . If the decision result in the step S3 is NO, a step S4 counts up the counted value of the timer 14. A step 5 S5 decides whether or not an interrupt transfer request is issued with respect to a concerned end point. The end point refers to a part forming an information source or sink during the communication between the host unit 2 and the communication device 10 1. The process returns to the step S3 if the decision result in the step S5 is NO. On the other hand, if the decision result in the step S5 is YES, a step S6 clears the counted value of the timer 14, and the process returns to the step S3. In addition, 15 if the decision result in the step S3 is YES, a step S7 disconnects the line which is being used for the communication, and the process ends.

The signal peculiar to the USB 4 is of course not limited to the interrupt transfer request 20 signal, and other signals such as a frame start (SOF) signal, a control transfer signal and a bulk IN transfer request signal may be used. The SOF signal is a packet which is issued from the host unit 2 for every $1.0 \text{ ms} \pm 0.05\%$, for example, and 25 indicates the start of each frame. This SOF signal is not issued with respect to a specific communication device or end point, but is issued periodically if the host unit 2 has an appropriate configuration. On the other hand, the control 30 transfer signal is issued when using a control transfer mode in which the communication device 1 transfers configuration information thereof or the like to the host unit 2 and the host unit 2 transfers configuration information thereof or the like to the communication device 1, and also when 35 transferring a small amount of data. The control transfer signal corresponds to a standard device

request or the like which is defined by the USB 4,
and thus, the control transfer mode is supported
without exception by any unit or device which
supports the USB 4. In addition, even in the case
5 of a request other than the standard device request,
it is possible to use a vendor request as the
control transfer signal to have a peculiar meaning.

When using the bulk IN transfer, it is
possible to use the bulk IN transfer request signal
10 similarly to the interrupt transfer request signal
described above.

When using the SOF signal as the signal
peculiar to the USB 4, it is possible to detect the
abnormality related to the hardware of the host unit
15 such as the cutting OFF of the power supply of the
host unit 2. In addition, when using the interrupt
transfer request signal or the control transfer
signal as the signal peculiar to the USB 4, it is
possible to detect the abnormality of the host unit
20 2 such as hang-up which is caused by software,
because both the interrupt transfer and the control
transfer are not only dependent on the hardware of
the host unit 2 but are also dependent on the
operation of the application software 21 and the
25 driver software 22 for carrying out the
communication. The above described signals peculiar
to the USB 4 are not implemented exclusively for
detecting the abnormality of the host unit 2, and
are used during the normal operation of the host
30 unit 2. For this reason, it is unnecessary to
modify the hardware and software of the host unit 2
in order to realize the present invention.

FIG. 3 is a diagram for explaining this
first embodiment. In FIG. 3, those parts which are
35 the same as those corresponding parts in FIG. 1 are
designated by the same reference numerals, and a
description thereof will be omitted. In FIG. 3, a

09706854-110700

connector 42 is provided on one end of a cable 41,
and a connector 43 is provided on the other end of
the cable 41. The connector 42 is connected to a
USB connector of the host unit 2, and the connector
5 43 is connected to a connector of the wireless
telephone set 3. The cable 41 forms the USB 4. In
addition, the communication device 1 shown in FIG. 1
is built into the connector 43. Accordingly, pins
of the connector 43 are provided in correspondence
10 with the data line 5-1, the command line 5-2 and the
control line 5-3. By providing the communication
device 1 within the connector 43, it is possible to
connect the host unit 2 and the wireless telephone
set 3 to the communication device 1 having the
15 function of automatically disconnecting the line, by
simply connecting the host unit 2 and the wireless
telephone set 3 by the cable 41.

FIG. 4 is a diagram for explaining a
second embodiment of the communication device
20 according to the present invention. In FIG. 4,
those parts which are the same as those
corresponding parts in FIG. 3 are designated by the
same reference numerals, and a description thereof
will be omitted. In FIG. 4, a connector 52 is
25 provided on one end of a cable 51, and a connector
53 is provided on the other end of the cable 51.
The connector 52 is connected to a USB connector of
the host unit 2, and the connector 53 is connected
to a connector of the wireless telephone set 3. The
30 cable 51 forms the USB 4. In addition, the
communication device 1 shown in FIG. 1 is built into
the host unit 2 or the wireless telephone set 3. By
providing the communication device 1 within the host
unit 2 or the wireless telephone set 3, it is
35 possible to connect the host unit 2 and the wireless
telephone set 3 to the communication device 1 having
the function of automatically disconnecting the line,

09706854-110700

by simply connecting the host unit 2 and the wireless telephone set 3 by the cable 51.

Next, a description will be given of a third embodiment of the communication device according to the present invention. In this third embodiment, a log storage section is further provided to store a log of the disconnection of the line, in addition to the structure of the first or second embodiment described above. For the sake of convenience, it is assumed in this third embodiment that the log storage section is formed by the internal buffer of the communication device 1. However, it is of course possible to form the log storage section by a memory or the like which is independent from the internal buffer. Moreover, the log storage section may be provided within the host unit 2 or within the wireless telephone set 3. By providing the log storage section and storing the log of the disconnection of the line, it is possible to access the log at an arbitrary time from the host unit 2 or, to automatically access the log and notify the log to the user of the host unit 2.

When restoring the host unit 2, the line controller 15 may re-connect to the line which was disconnected, using the log which is stored in the log storage section.

Next, a description will be given of a fourth embodiment of the communication device according to the present invention. In this fourth embodiment, a notifying section is further provided to notify the disconnection of the line to the host unit 2, in addition to the structure of any one of the first through third embodiments described above. In this fourth embodiment, it is assumed for the sake of convenience that the notifying section is formed by the line controller 15. In other words, the line controller 15 of this fourth embodiment

09706854 110700

instructs the disconnection of the line to the wireless telephone set 3, and also notifies the disconnection of the line to the host unit 2 via the USBIF 11 and the USB 4.

5 It is possible to employ a known notifying means when notifying the disconnection of the line to the user of the host unit 2. In other words, the disconnection of the line may be notified to the user by a display output using LED or the like, and
10 an audio output using a buzzer, a melody, voice message or the like. In addition, in a case where an electronic mail function is provided in the wireless telephone set 3 for sending electronic mail, this electronic mail function may be used to notify
15 the disconnection of the line to a manager or the like at a remote location by sending an electronic mail.

 Further, the present invention is not limited to these embodiments, but various variations
20 and modifications may be made without departing from the scope of the present invention.

25

30

35

09706854 110700